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STANDARD ACCESSORIES

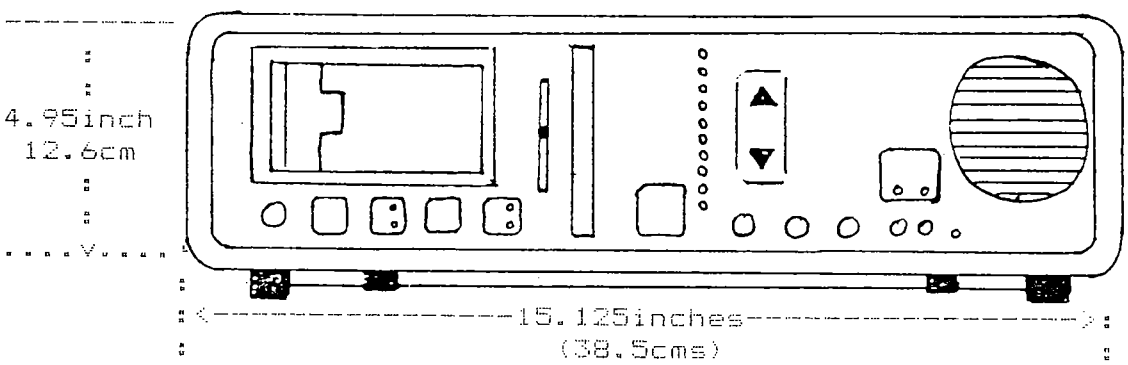
1...Operator Instruction Manual
1...Doppler Transducer
1...Photo Transducer
1...Line Cord

OPTIONAL ACCESSORIES

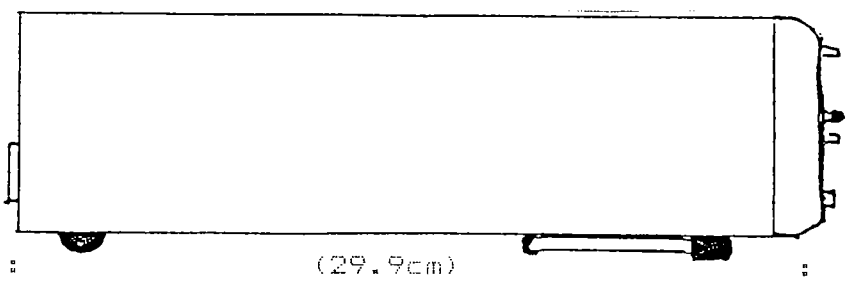
1...RS232 Board....installed on request
1...RS232 Patch Cord
1...Service Instruction Manual

Physical Dimensions Weight 8.0lbs 3.64kgs

Front View



Side View



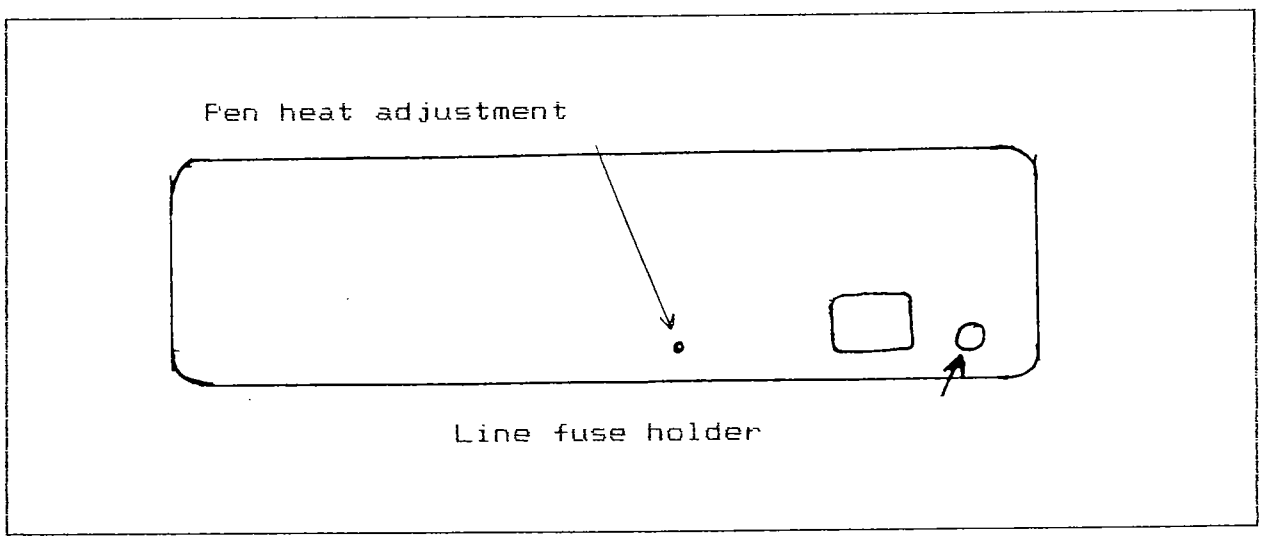
OPERATING INSTRUCTIONS

The MD35 unit operates on 120 VAC 60 HZ.....Japanese and European voltages models are available.

Before proceeding...be sure that the outlet to be used is equipped with a three prong receptacle.

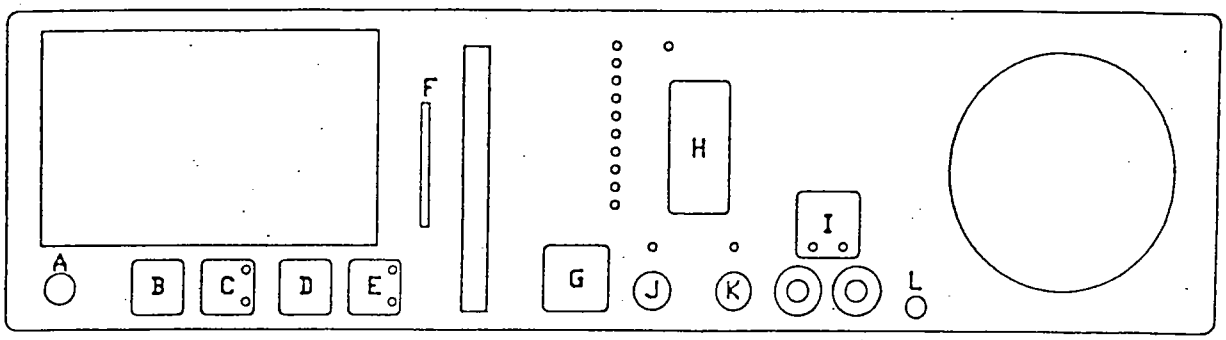
FUSE LINE	FUSE
120 VAC	3 AG 0.5 slow
240 VAC	315 MA slow

Fuse spefications



MD 35 Back View

Fig. 1



Power Consumtion 20 Watts

MD 35 FRONT PANEL

Location and operation of external controls..connectors..indicators:

(A)...Power:
Push-button switch...Push in for **on**. Push and release for **off**.

(b)...Run Stop:
Alternate-action push button switch to **start** and **stop** the chart recorder...This duplicates the action of the push-button on doppler probe.

(C)...Speed:
Push-button to set chart recorder speed...**Slow** (5mm/sec) **Fast** (25mm/sec).

(D)...Zero:
Push-button to balance the plethysmographs...This offsets any baseline shift, so that small changes can be amplified even though they may have a large baseline offset....Applying this switch also gives a zero flow signal in doppler mode to show the baseline level.

(E)...Art/Vein:
Push button to select coupling of output for plethysmograph modes...In doppler mode the instrument is always DC coupled because the zero flow level for doppler has no offset.

Use **ART**ery (AC) coupling when the baseline level is not desired and only pulsatile information is wanted.

Use **VEIN** (DC) coupling for venous examinations when long term baseline changes are important.

Locations etc. continued from page 6

(F)...Position:
Slide control for neutral position of baseline on the chart recorder and display bar graph.

(G)...Select:
Push button to **select** mode of operation.

(H)...Range:
Two push buttons to select the **gain** or **sensitivity** of the output signal as is reflected by the chart recorder reading and the display bar graph.
(Typical ranges for use will be from 1 to 0.01 Khz for the doppler. The pneumoplethysmograph can only be calibrated by injecting a known volume of air in the sensing cuff....In practice this is seldom done...Calibration for the photo-plethysmograph is also not signifant.)

(I)...Pneumo:
One of the lights on this switch will be lit whenever pneumo mode is selected. Applying the switch will toggle between **REC**ord and **INFL**ate mode.In inflate mode a cuff, connected to the blue port, can be inflated via the black port by the use of a cuff-inflater. In **REC**ord mode the cuff is sealed by an internal valve and the cuff-inflater can be removed for use on another cuff.

(J)...Doppler:
Connector for the doppler transducer... The small black button on the top of the connector must be depressed in order to disconnect or remove the transducer.The light above the connector will indicate that doppler mode has been selected.

(K)...Photo:
Connector for the infra-red photo transducer...The small black button on the top of the connector must be depressed in order to disconnect or remove the photo transducer. Do not pull on cable to remove the plug. The light above the connector will indicate that photo has been selected.

Locations etc. continued from page 7

(L)...Phones:
A miniature phone jack for headphones...Both sides of the jack are wired to the same signal with no stereo effect.

(M)...Doppler Controls:
Controls on the doppler probe include...The volume control thumbwheel...The push button (on back of probe) to start and stop the chart recorder...The toggle switch to invert the output waveform.

(N)...Serial Data Out:
A rear panel jack for optional computer interface...This signal is an electrically isolated, serial digit, interface available for connecting the output to a computer. the jack is only installed in units equipped with the optional RS232 Serial interface board. When using the MD-35 with a computer it is important not to make any electrical connection to the computer other than through the the RS232 caole in order to insure electrical isolation of the instrument.

Loading Paper Into The Chart Recorder

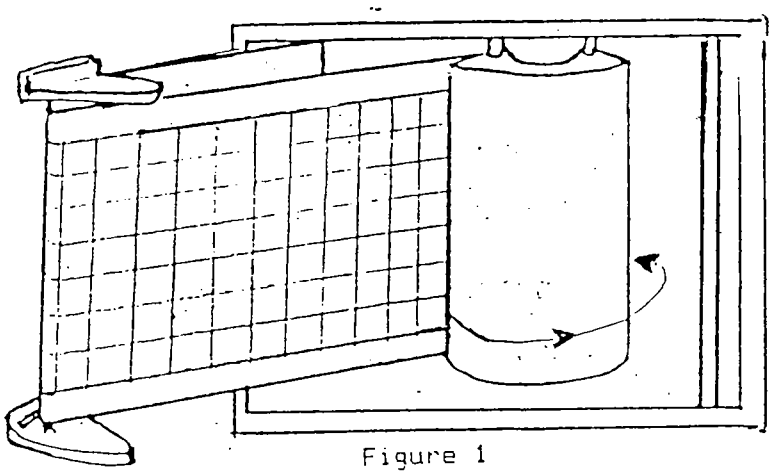


Figure 1

1...Load paper roll with paper unrolling counter clockwise as shown in fig. 1

2...Loop end of paper around open door. fig 1

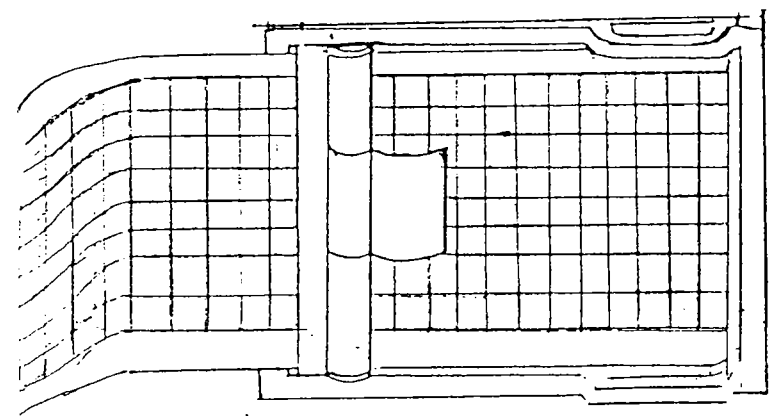


Figure 2

3...Close door and feed paper through the left spindle on door. fig 2

4...Turn on chart recorder to assist the feeding action. Recorder is now ready for use.

Performance Check

Turn on unit by pressing the red button.Observe the following lights that are on:

Speed Control.....5
ART/VEIN.....AC
Range.....0.5
Photo.....Photo
Display.....Display Bar

Push run/stop button to start chart recorder. Push speed button and watch for speed lights changing alternately each time it is pushed. When 5 is lit speed is slow and with 25 it is fast.*

Check the operation of the range lights. They should change in the direction of the arrow heads.

Pressing the select button will change the mode from photo to pneumo to doppler and back to photo....always in the same direction. When pneumo is pressed you should hear the valve activated and the REC and INFL lights should light up alternately with each application of the button.

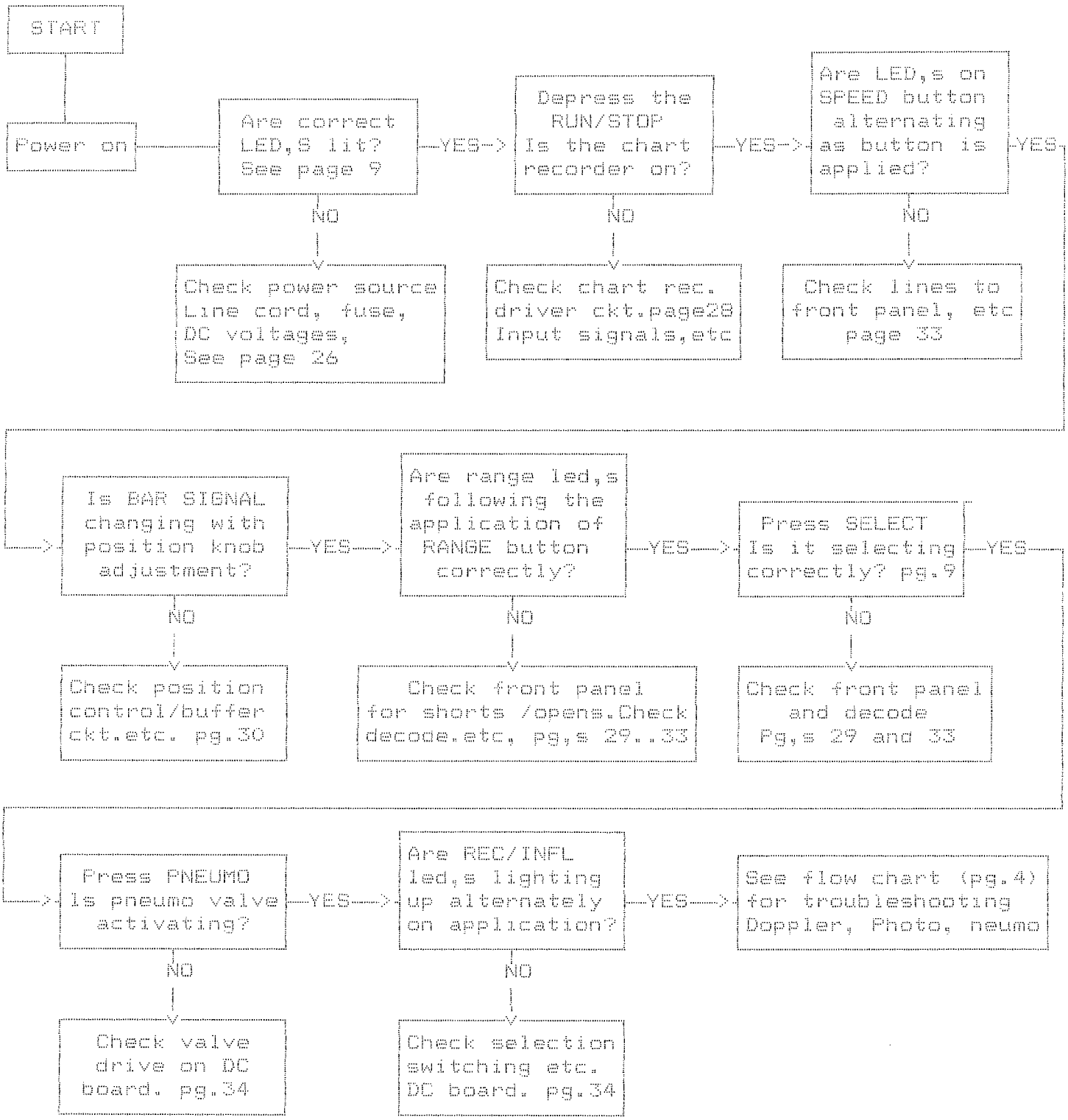
Detailed information on performance in the various modes can be found in the operation sections as follows:

	Page
Photo (AC)	41 and 42
Pneumo (AC)	37
Doppler	43 through 45
Photo (DC)	41 and 42
Pneumo (DC)	36 and 37

*

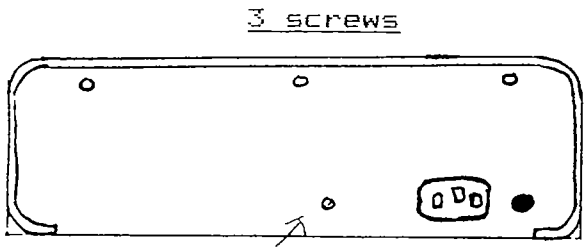
*

Flow Chart for Performance Check


START
Power on
Are correct LED,S lit? See page 9
YES->
NO
Check power source Line cord, fuse, DC voltages, See page 26
Depress the RUN/STOP Is the chart recorder on?
YES->
NO
Check chart rec. driver ckt.page28 Input signals,etc
Are LED,s on SPEED button alternating as button is applied?
YES->
NO
Check lines to front panel, etc page 33
YES
Is BAR SIGNAL changing with position knob adjustment?
YES->
NO
Check position control/buffer ckt.etc. pg.30
Are range led,s following the application of RANGE button correctly?
YES->
NO
Check front panel for shorts /opens.Check decode.etc, pg,s 29..33
Press SELECT Is it selecting correctly? pg.9
YES->
NO
Check front panel and decode Pg,s 29 and 33
YES
Press PNEUMO Is pneumo valve activating?
YES->
NO
Check valve drive on DC board. pg.34
Are REC/INFL led,s lighting up alternately on application?
YES->
NO
Check selection switching etc. DC board. pg.34
See flow chart (pg.4) for troubleshooting Doppler, Photo, neumo

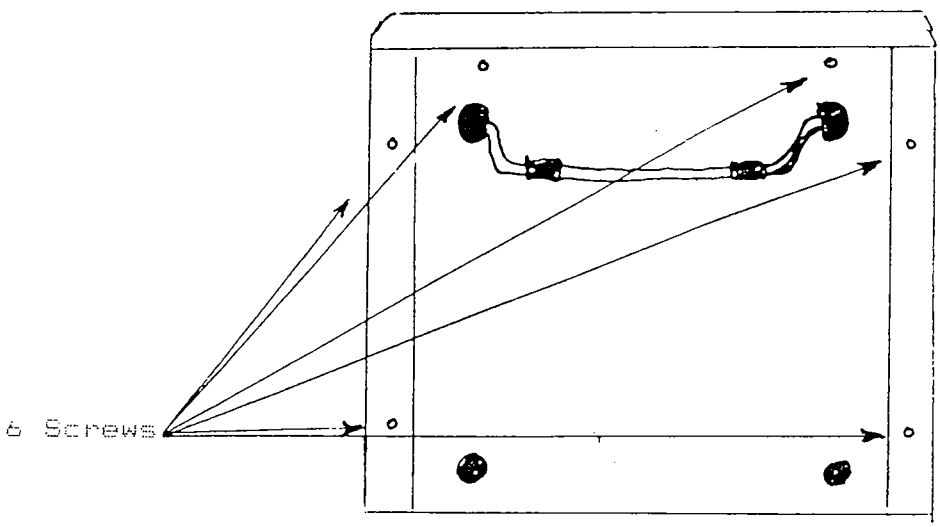
Lid Removal

Take a phillips screwdriver and remove the 3 screws in back shown below.



Back View

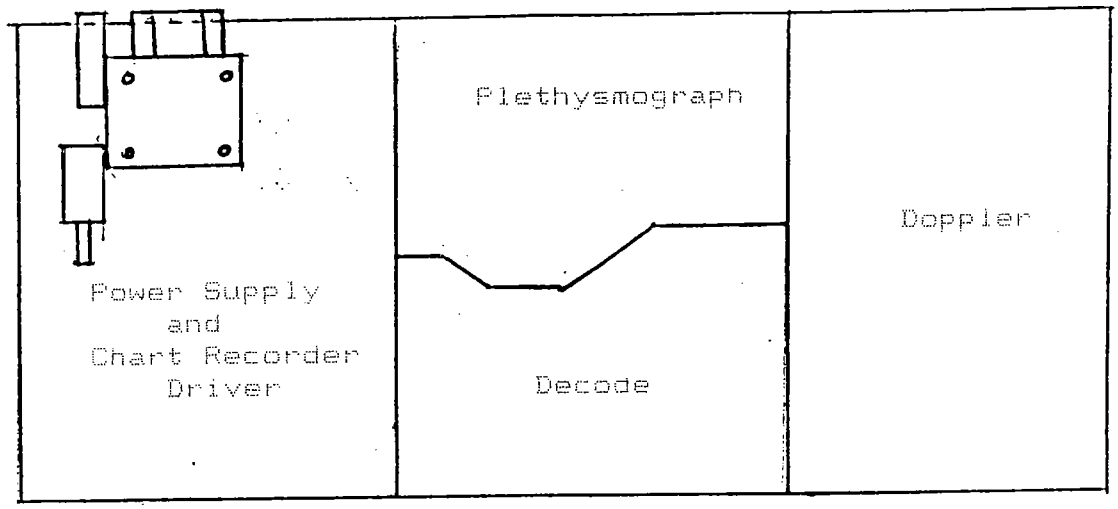
Place unit on its back and remove 6 screws from bottom shown below



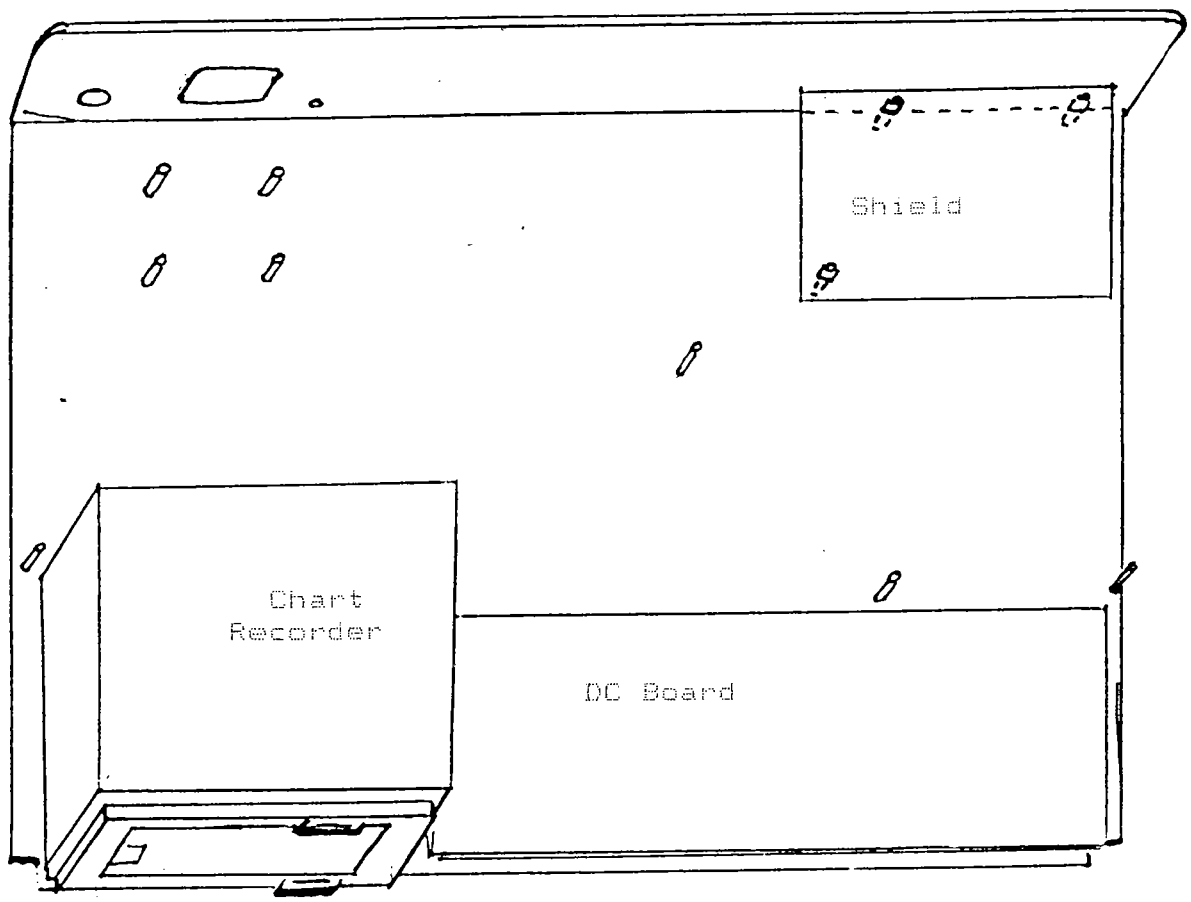
Bottom View

Gently lift the lid up about 2 inches. Lay unit on legs and bend the right side of the lid at the back, away from the chassis to the right. Carefully slide the lid out and up, allowing clearance for IC,s and caps etc, until all of the right side is clear. Pull off both pneumo hoses at the front panel to give the lid greater freedom.

Familiarization



Main Board



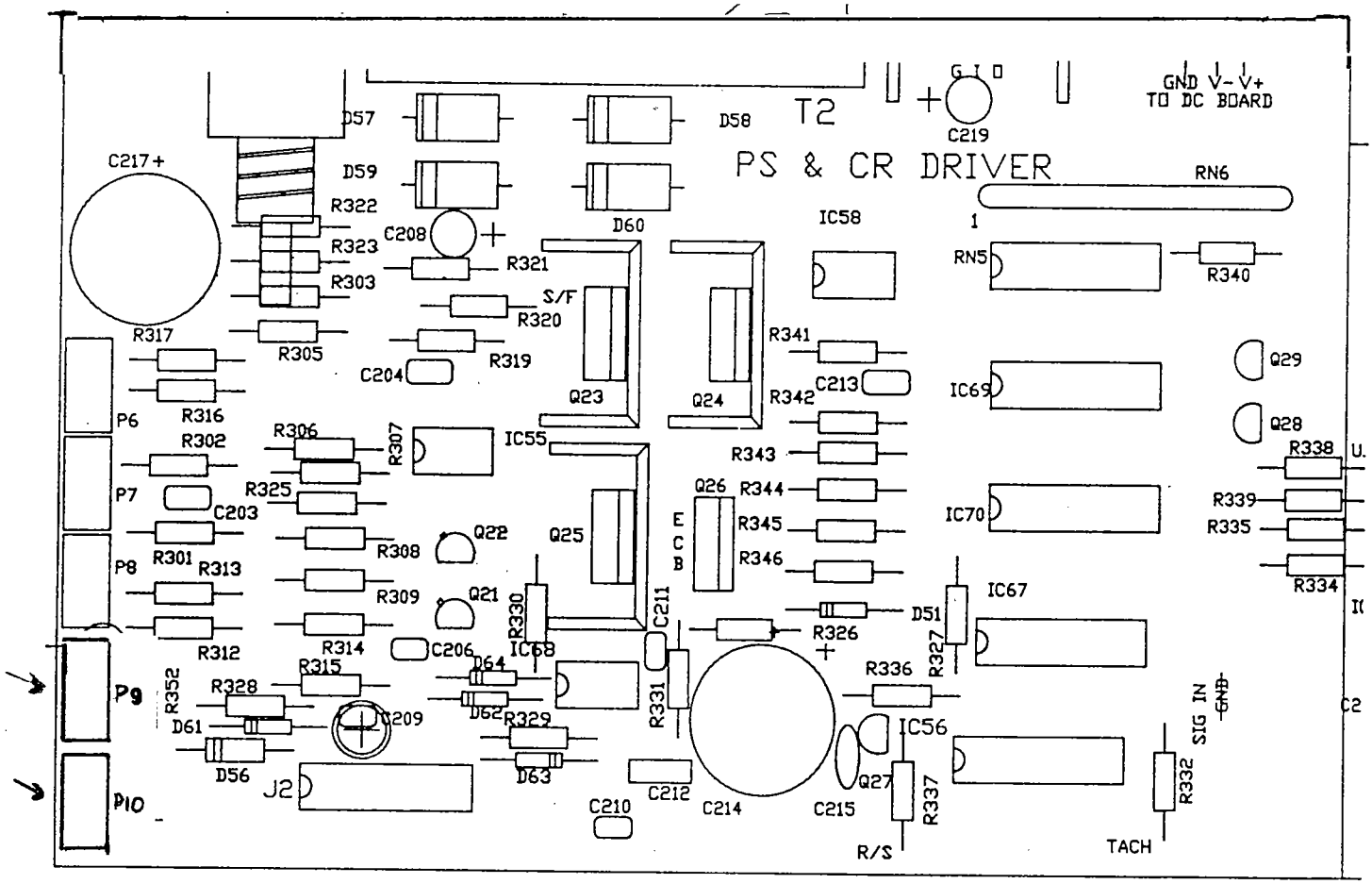
Chassis

Adjustments

When lid is on:

PEN HEAT can be adjusted to change the boldness of the line recording on chart paper. Adjustment screw is located on back of the unit as shown on fig,1 page 5

CHART RECORDER SPEED can be adjusted on some older models by adjusting P9 and P10 on the chart recorder driver section (below) Hook a frequency counter to pin 1 of IC57, Set the speed to slow and turn on chart recorder. Adjust P9 until counter reads 38Hz. Set speed to fast. Adjust P10 until counter reads 190Hz.
* Models that do not have P9 and P10 are equipped with self-adjusting speed control circuitry.



Power and Chart Recorder Drive

Troubleshooting Aids

Troubleshooting Chart:
Use troubleshooting charts.....Doppler (page 23).....Photo (page 24) Pneumo (page 25).

Schematics:
A listing of individual schematics is on page 3.

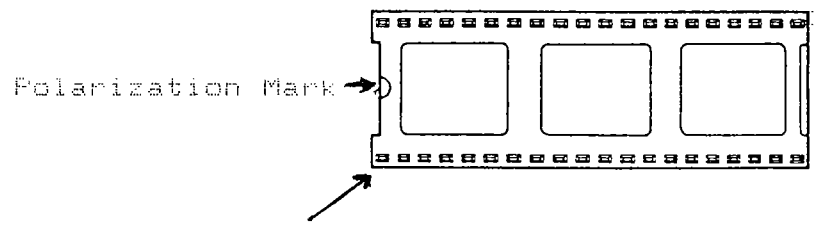
Diagrams:
Complete circuit diagrams and flow charts for each board are listed in table of contents....pages 2 and 3.

Layouts:
Layouts with grid locations can be found in the table of contents. Helpfull drawings and diagrams can be found throughout this manual and are listed on pages 2 and 3.

Colour Codes:
All ground lines, board to chassis etc,are green with a yellow stripe. All ground lines board to board are green.

Resistors:
Resistors are coded with EIA color code. The cathode end of each diode is indicated by a stripe.

Semiconductor Configuration:
Pin 1 on sockets and cable connecting sockets is on the bottom left hand location, looking at the top of the chip. It can be recognized by a mark on the socket as shown below:



Pin 1

Please note that all sockets on the doppler section are mounted up-side down.

Troubleshooting Equipment

Test Oscilloscope:
Purpose....To check operating voltages and wave forms.

Multimeter:
Purpose....To check operating voltages, resistances and if needed current in different areas .

Frequency Generator:
Purpose....To inject set frequencies at certain points in the circuit and compare waveform response to expected waveforms at these points.

Troubleshooting Techniques

Check Control Settings:
See operating instructions (page 6). Check associated equipment and/or connectors with specific problems: transducers, cuffs power cord, power source, fuse etc.

Check Performance Specifications:
If instrument does not meet specifications this could possibly be corrected by re-adjustment (page 13).

Visual Check:
A visual check should be performed and could reveal broken connectors, damaged components, loosened semiconductors, damaged circuit boards, etc.
One can often isolate a problem to a particular area by assessing the symptoms and visually inspecting the appropriate area.

Check Voltages and Waveforms:
Often a defective component can be found this way.

Check Individual Components:
The best check of most chips, transistors and diodes, etc. is while they are operating in the circuit. If an IC is suspect, replace it with a new one. Before checking IC,s familiarize yourself with the circuit description.

Resistors:
Check for discoloration. Ohm out resistors in suspected area.

Inductors:
Check for opens. Shorted or partially shorted inductors can be found by checking waveforms while a high frequency signal is being injected into the circuit. Partial shorting often reduces the high frequency response (increases roll off).

Capacitors:
A leaky or shorted capacitor can be detected by checking the resistance with an ohmeter. The resistance reading should be high after initial charge of capacitor. An open capacitor can be checked by a capacitance meter or by checking that capacitor passes AC signals.

After repairing a circuit, check the unit performance. If the problem was in doppler, check doppler calibration. If elsewhere check overall calibration.... speed etc.

Troubleshooting Hints

Example (1)

Symptom.... Bar graph signal seems to be stuck at bottom of display. When position bar is pushed up the bar graph signal only moves up halfway.

Assessment.... Plethysmograph has an offset problem. Suspect a DC power source (regulator) malfunction to the position control or buffer area.

Check minus voltage supply to level shifter (IC40 ,-5v). If voltage is not there check its source (IC35, -12v). Usually IC40 will be the cause; It is being used as a zener diode holding the output to -5v. If IC35is good, replace IC40. If IC35 is not giving a -12v output, keep checking until you can establish the reason, bad cap, no -17v to IC35 or whatever, and re-establish the the -12v.

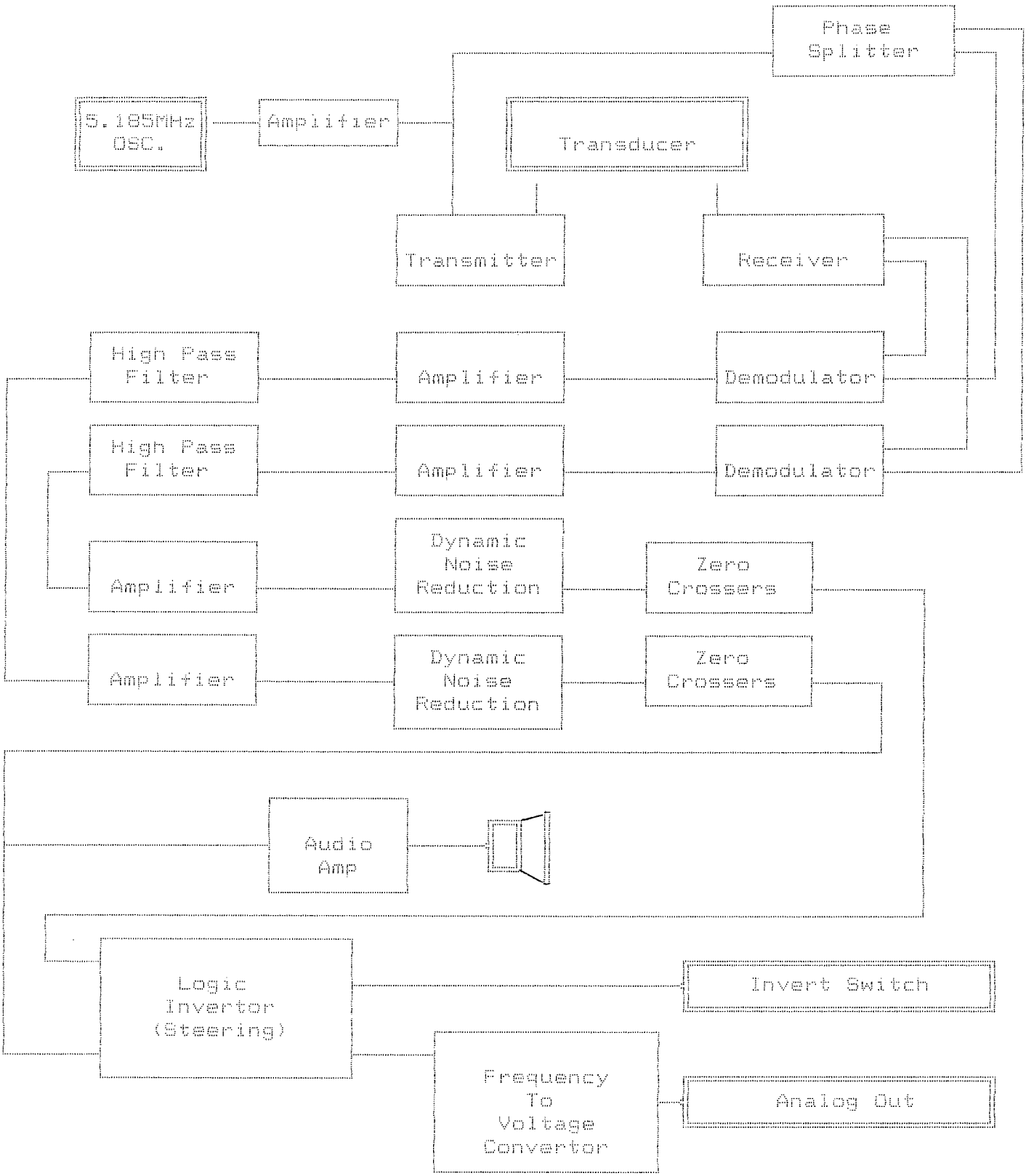
Example (2)

Symptom.... No audio.
When doppler is selected and volume knob is turned up there is no sound.

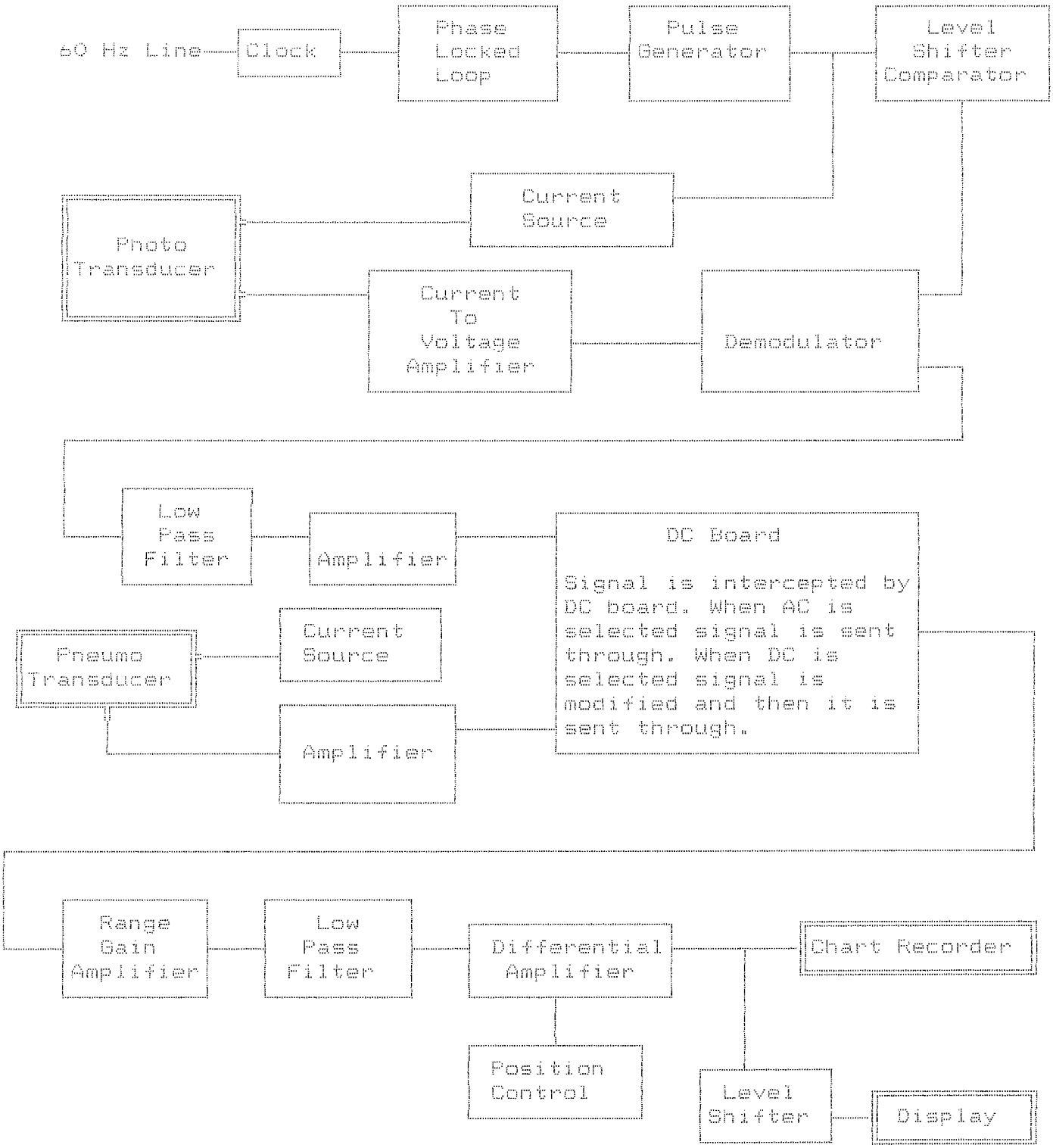
Assessment.... When you change in and out of doppler you should hear a soft "pop" sound with the volume control up or down. If there is a "pop" then the problem could be in the volume control circuit or in the handle etc. Examine all possibilities.

If when you change in and out of doppler you do not hear a "pop" then it may be that the problem is either in the mute circuit or in the audio circuit itself. However, as the audio circuit has proven to be very reliable and long lasting through time, most likely the fault is elsewhere.
Take readings and waveforms using the information given on schematic....page 31.

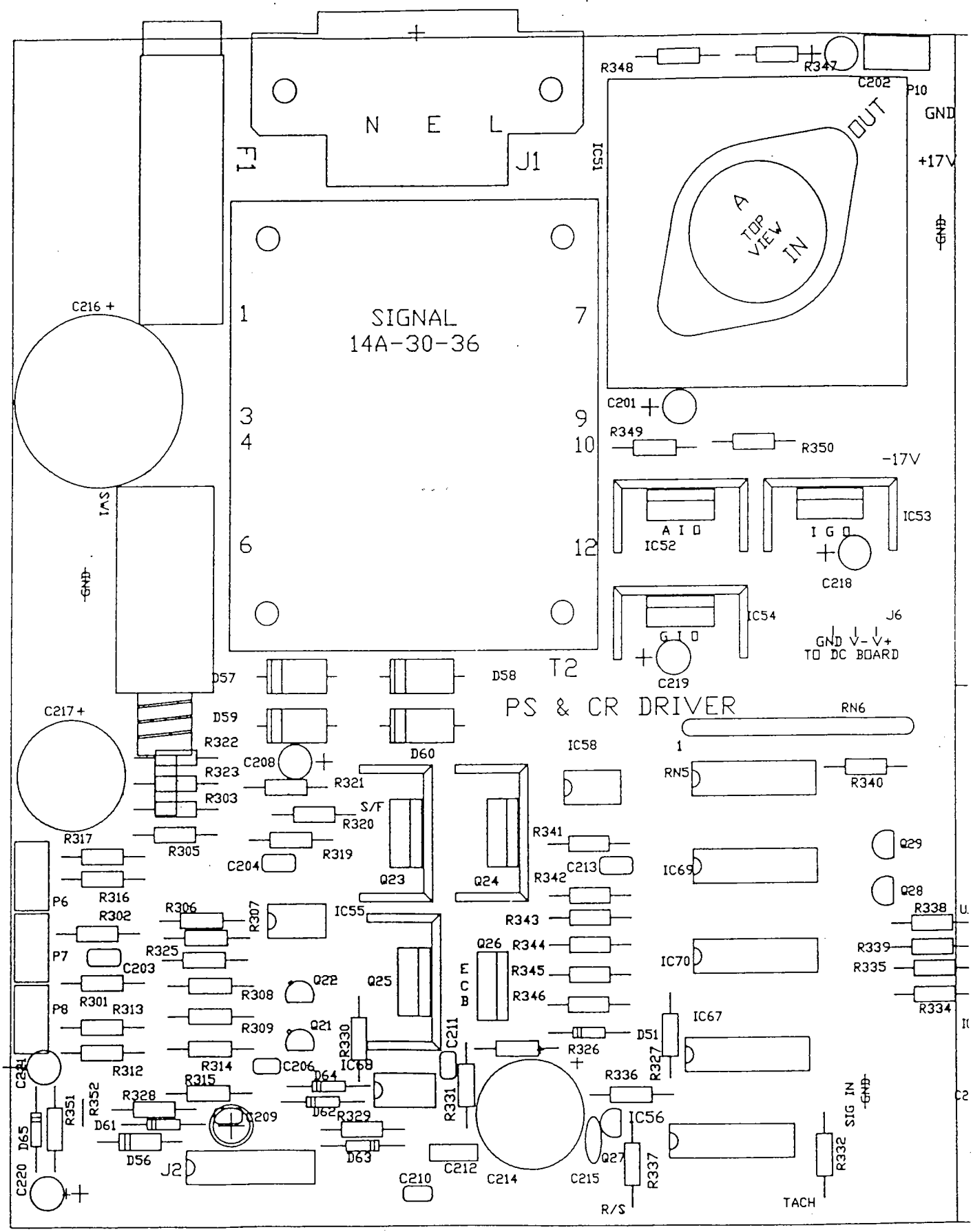
Doppler Block Diagram



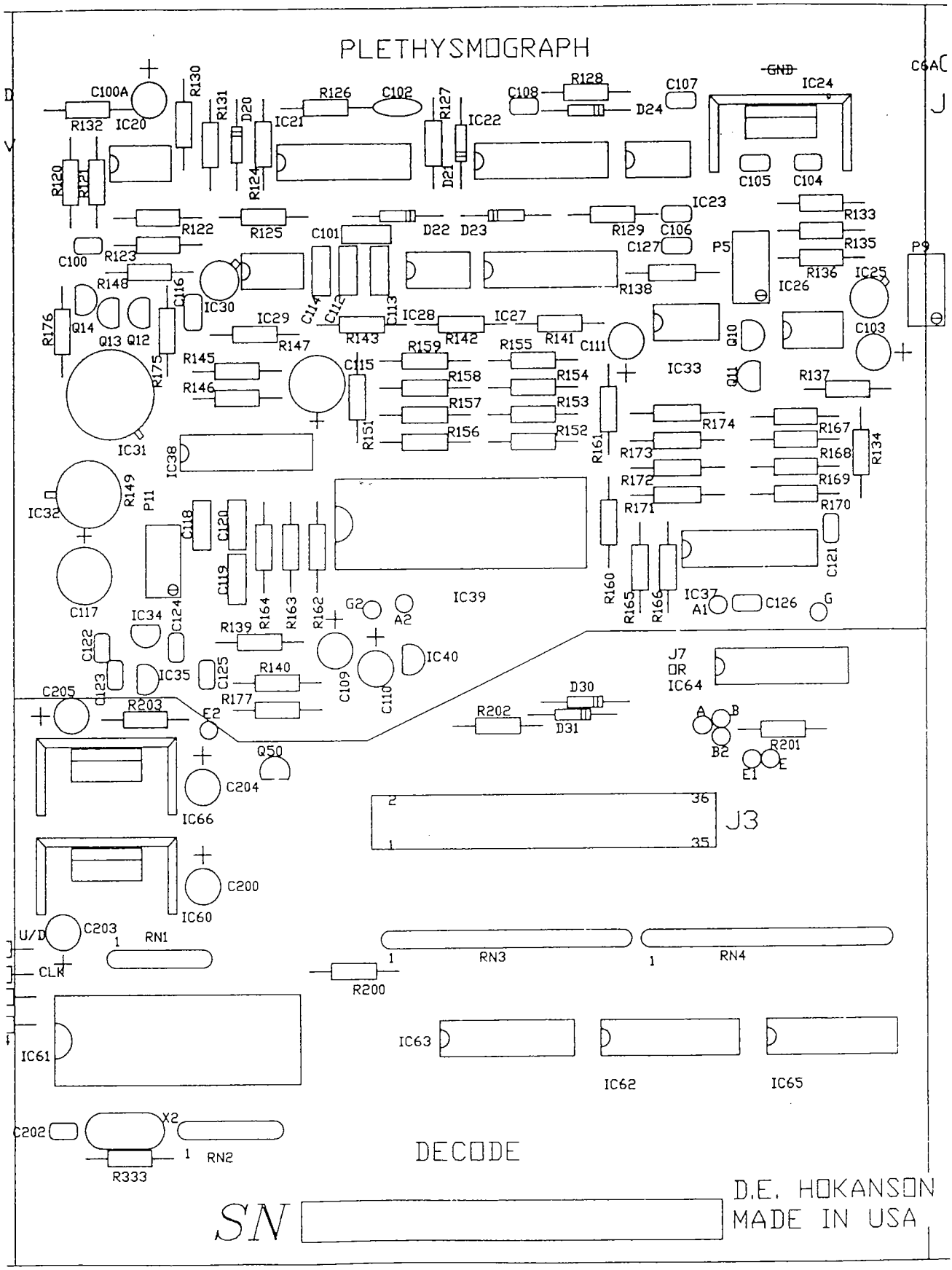
Plethysmograph Block Diagram



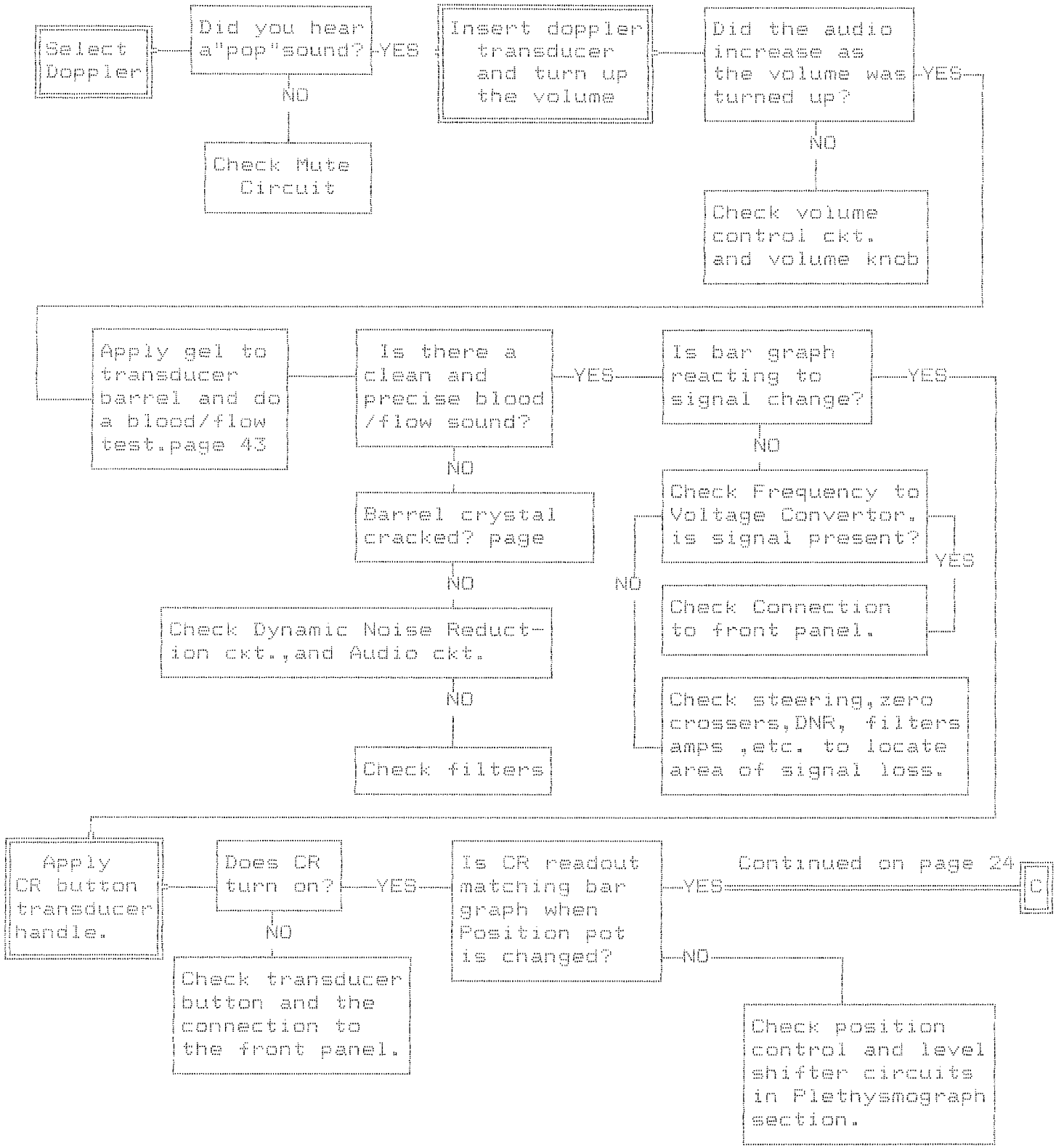
Power and Chart Recorder Drive Layout

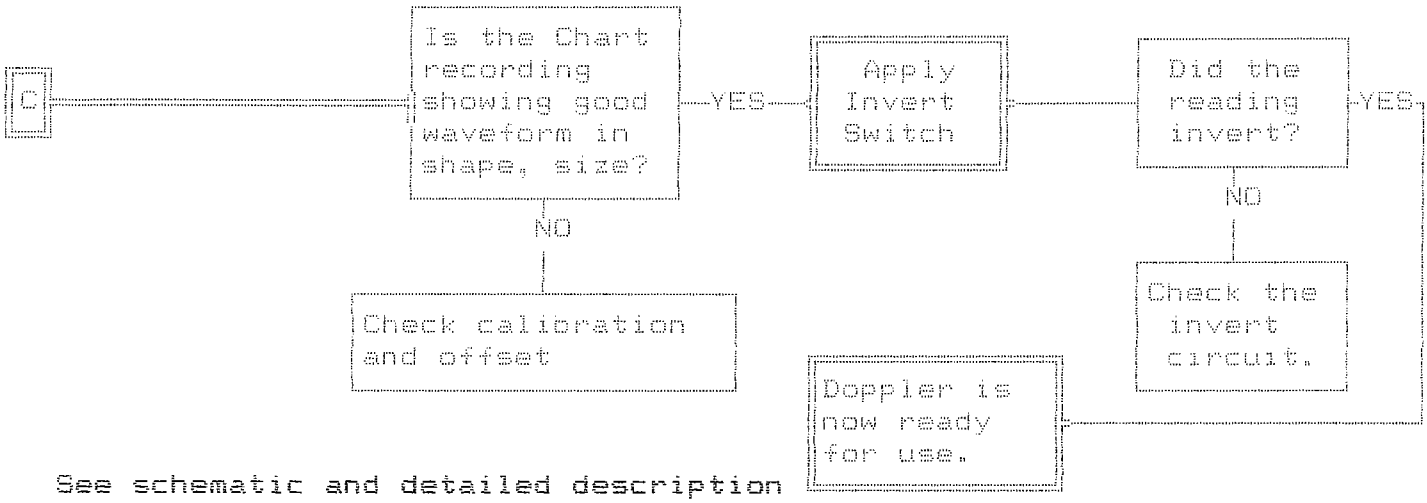


Plethysmograph and Decode Layout



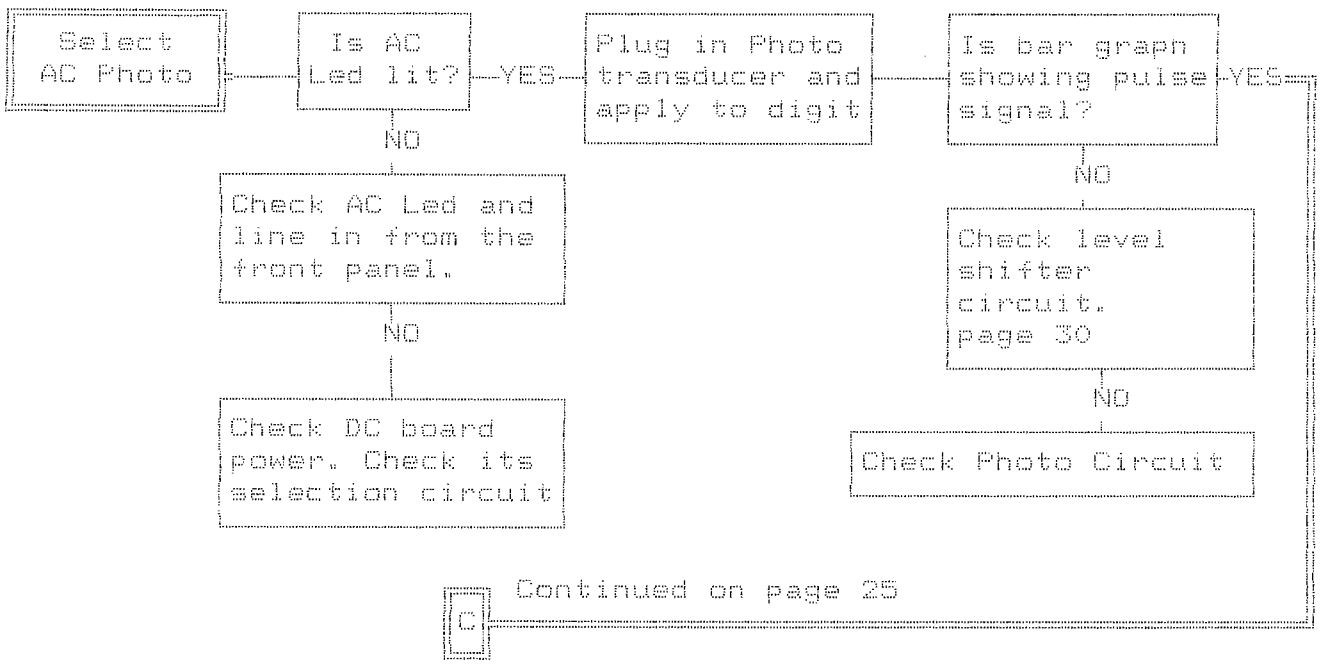
Flow Chart For Troubleshooting Doppler


Select Doppler
Did you hear a"pop"sound?
YES
NO
Check Mute Circuit
Insert doppler transducer and turn up the volume
Did the audio increase as the volume was turned up?
YES
NO
Check volume control ckt. and volume knob
Apply gel to transducer barrel and do a blood/flow test.page 43
Is there a clean and precise blood /flow sound?
YES
NO
Barrel crystal cracked? page
NO
Check Dynamic Noise Reduct-ion ckt.,and Audio ckt.
NO
Check filters
Is bar graph reacting to signal change?
YES
NO
Check Frequency to Voltage Convertor. is signal present?
YES
NO
Check Connection to front panel.
Check steering,zero crossers,DNR, filters amps ,etc. to locate area of signal loss.
Apply CR button transducer handle.
Does CR turn on?
YES
NO
Check transducer button and the connection to the front panel.
Is CR readout matching bar graph when Position pot is changed?
YES
Continued on page 24
C
NO
Check position control and level shifter circuits in Plethysmograph section.

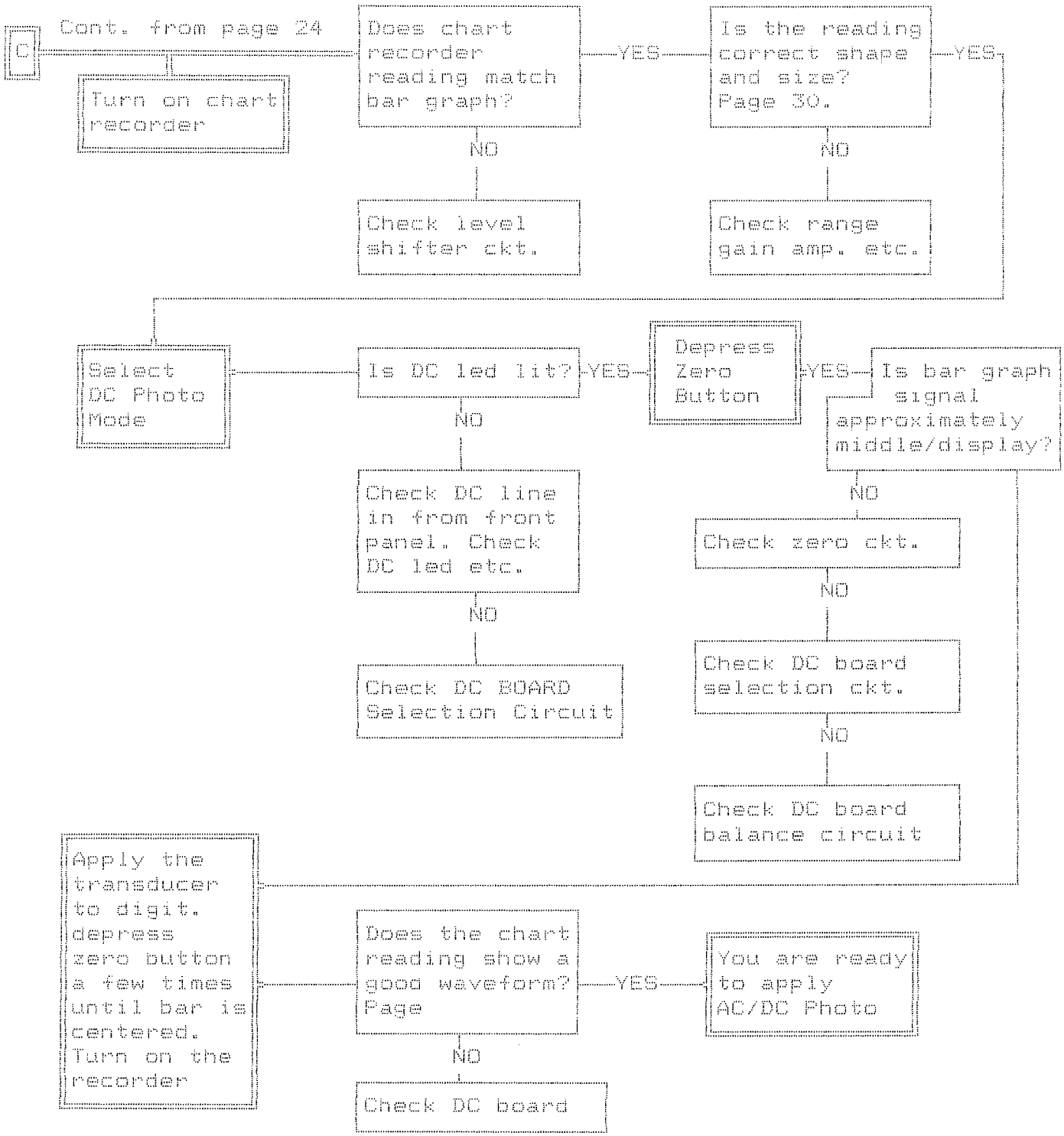


See schematic and detailed description on page 31

Flow Chart for Troubleshooting Photo



Flow Chart for Troubleshooting Photo


C
Cont. from page 24
Turn on chart recorder
Does chart recorder reading match bar graph?
YES
Is the reading correct shape and size? Page 30.
YES
NO
Check level shifter ckt.
NO
Check range gain amp. etc.
Select DC Photo Mode
Is DC led lit?
YES
Depress Zero Button
YES
Is bar graph signal approximately middle/display?
NO
Check DC line in from front panel. Check DC led etc.
NO
Check DC BOARD Selection Circuit
NO
Check zero ckt.
NO
Check DC board selection ckt.
NO
Check DC board balance circuit
Apply the transducer to digit. depress zero button a few times until bar is centered. Turn on the recorder
Does the chart reading show a good waveform? Page
YES
You are ready to apply AC/DC Photo
NO
Check DC board

DC VOLTAGES

MAIN BOARD:
Power and chart recorder drive.

Unregulated voltage V +.....+28V

Unregulated voltage V -.....-28V

IC51.....+17V

IC52.....-17V

IC53.....+12V

IC54.....-12V

Plethysmograph.

IC34.....+12V

IC35.....-12V

IC40.....-5V

IC24.....+12V

Decode.

IC60.....+5V

IC66.....+12V

Doppler.

IC13.....+12V

IC14.....-12V

DC BOARD:

D+12V.....(+11.5V to +12.5V).....Pin 16 of IC7

A=12V.....(+11.5V to +12.5V).....Pin 7 of IC13

A-12V.....(-11.5V to -12.5V).....Pin 4 of IC13

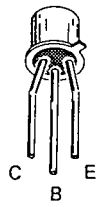
Ref A.....(-9.8V to -10.2V).....Pin 1 of IC11

+5V.....(+4.95V to +5.05).....Pin 14 of IC15

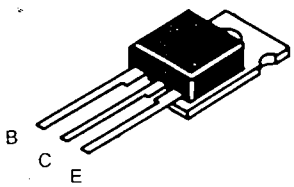
Clock.....Activated by zero button Pin 3 of IC4

Component Pin Designations

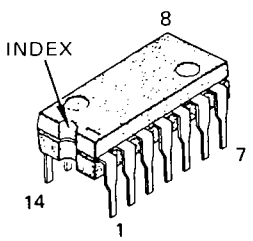
FET

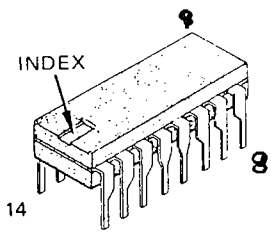


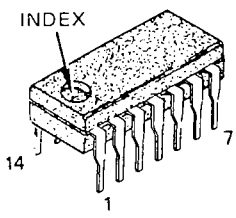
TRANSISTORS

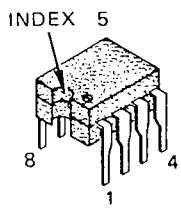


FLAT PACK TRANSISTORS









INTEGRATED CIRCUITS